Space Weather Technical Forecast

Issued on Sunday, 12 June 2022 at 13:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low in the last 24 hours, with minor C-class flares from the region of AR3030, which is now considered as two separate regions although interconnected. The westernmost one AR3030 Csi/Beta and the region to the east unnumbered Dsc/Beta. Both are small however, so despite some flux emergence being observed, especially in the westernmost region, only a very modest increase in activity has occurred. There are three other sunspot regions (for five total), however these are all small and simple. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1 showed a mark rise from background at 12/0800 UTC, rising quickly from 350-400 km/s to around 450-500km/s, likely due to the arrival of coronal hole fast wind. Density fell from above average to below average levels. Total Interplanetary magnetic field strength, Bt, was initially weak but gradually increased to be Moderate at 12-15nT. The north-south component, Bz, has varied weakly between +/-7 nT at first, but strengthened after 12/0800 UTC, generally becoming negative, with brief peaks at -11nT and +13nT. The phi angle was positive (away from the Sun). Geomagnetic activity, however, remained Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was at Background levels. Electron flux (greater than 2MeV) was also at background levels. Corresponding 24-hour integrated electron fluence has been well below the Active (1e8 integrated pfu) threshold on a largely steady trend, with 1.65e6 integrated pfu observed at 12/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low through this period, with C-class flares likely and a slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs were observed in available satellite imagery. Solar winds are expected to be mainly at background levels initially, with some enhancements possible, due to small and transient coronal holes. An increase near to 500 km/s was observed at the STEREO-A spacecraft, which may reach Earth during Day 1 (12 June). CH91/+ is then likely to give another enhancement later Day 3 or on Day 4 (14-15 June). However, geomagnetic response from coronal hole high speed streams is usually muted near the solstice. As such, geomagnetic activity is expected to be mainly Quiet to Unsettled, with a chance of Active intervals, especially on Days 1 and 4.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10 MeV) is expected to be at background levels during this period. However, there is a very slight increase in the chance of S1 as AR3030 transits westwards. High energy electron flux (greater than 2 MeV) is expected to start at background levels, perhaps increasing to moderate levels during the period due to high speed stream influences. Electron fluence is expected to remain below the Active threshold throughout, possibly with an increasing trend.

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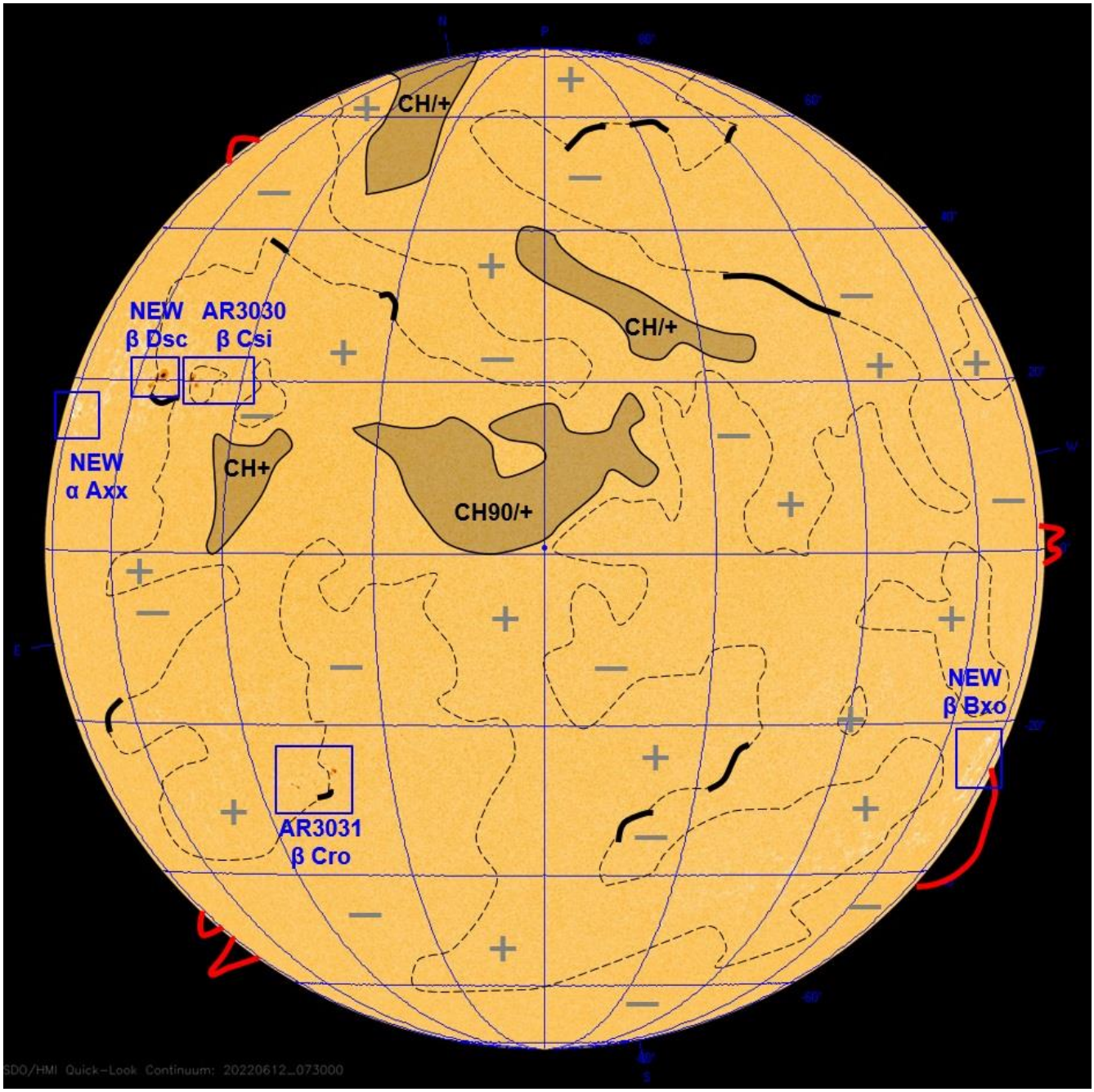
Figure 1. Solar Analysis Valid 12/0800 UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs

Solar winds are currently rising due to the arrival of the fast wind early on 12th, although the source of this fast wind is uncertain, perhaps related to small features that are no longer visible. Winds then likely to remain slightly elevated to elevated through the period with a sequence of further coronal holes on the Earth-facing disc. Solar winds will erratically ease days 2 and early day 3 (13th and 14th) with ongoing influence from the northwest quadrant CH (currently not numbered) before likely rising again later day 3 and day 4 (15th) with the arrival of fast winds from CH90.

This period of mainly slightly elevated to elevated winds is supported by the MOSWOC 27-day solar wind persistence model, and whilst the shape of the coronal holes has changed from the previous rotation, they are still evident on the disc. This is also supported by ongoing slightly elevated to elevated winds observed at STEREO A. Similar geomagnetic activity is expected, remaining mainly Quiet with Unsettled spells, but with a chance of isolated Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Solar Wind Persistence Model

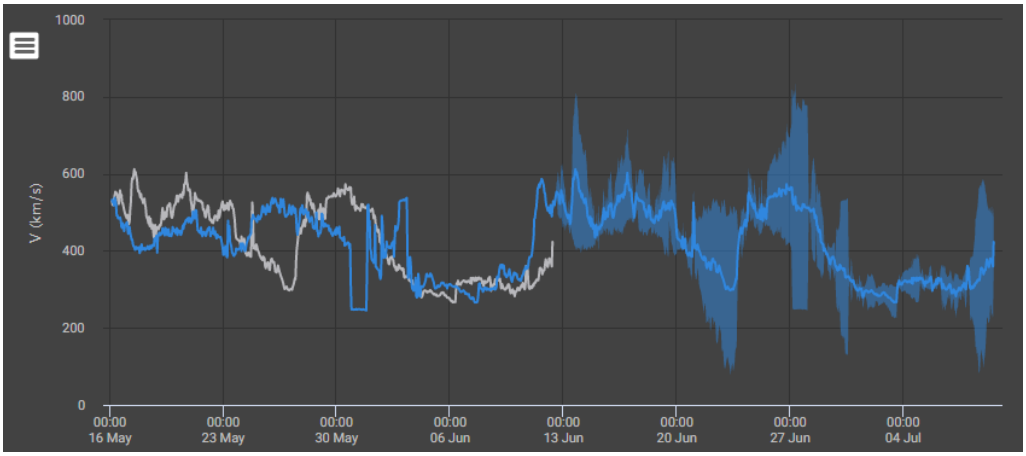

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Figure 3: SDO aia-211 of previous rotation (left) and current rotation (right)

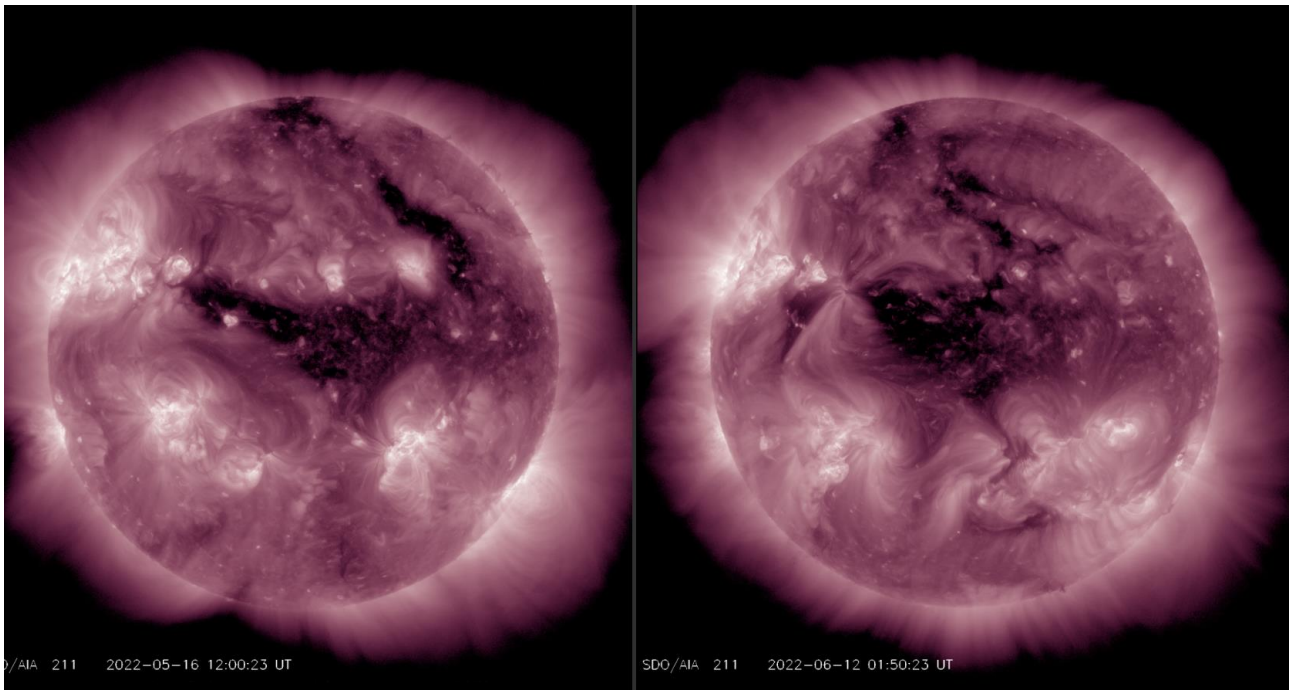

Figure 4: Observed solar winds for the last 24 hours.

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Radio Blackouts - X-Ray Flares:

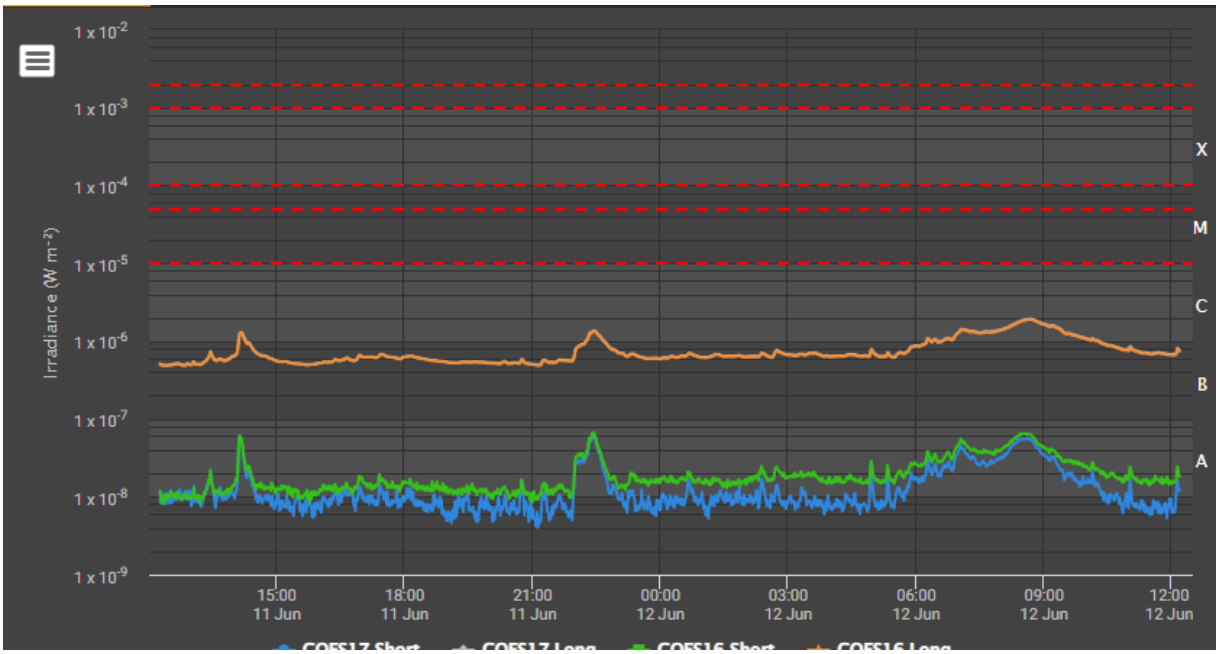
Solar Activity is currently Low, with recent C-flares observed, all in the vicinity of AR3030 Csi/Beta and the still yet to be numbered Dsc/Beta following region. These two regions are in close proximity, and have previously been considered as a single group, but due to the development of two distinct leader-trailer pairs and the separate flux emergence that is evident on the SDO-magnetogram, they are now more accurately represented as two regions. AR3030 has shown some simplification with its leader spot despite some flux emergence in its intermediate region, while some growth has been observed in the following region with the development of a clear trailer.

There is a further small sunspot group AR3031 Cro/Beta in the southeast quadrant, and two very small regions near the southeast limb.

Despite the small size of these sunspots, there is the potential for M-flares, especially if any further growth occurs in the region following AR3030. Activity is forecast to be Low, with a chance of rising to Moderate.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	25
Very Active	R3 to R5 X Class	No	2	2	2	2

Figure 5: GOES 16/17 X-ray Flux



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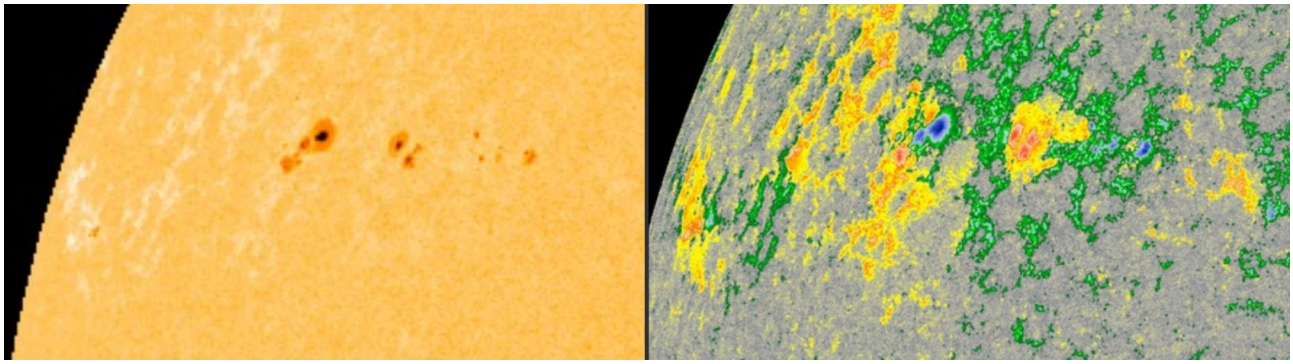
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is currently expected to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	2	2
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 6: SDO hmi-intensitygram and magnetogram of northwest disc, showing AR3030 and clear distinction between the two regions.



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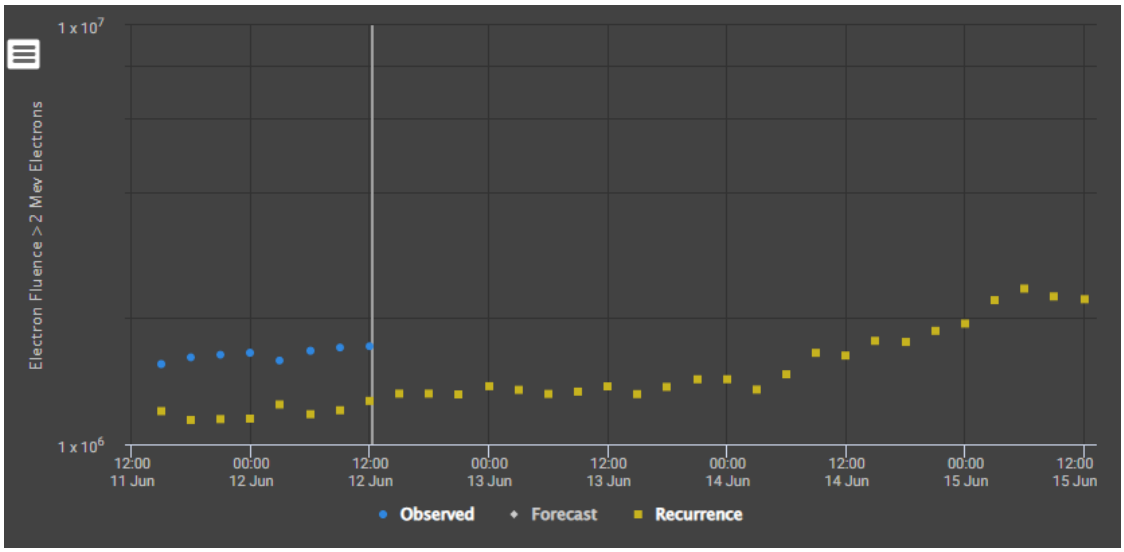
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 is expected to remain at mainly Background levels through the start of this period. Possible high speed stream influences may give an increase in wind speeds through this period, which could start to cause some minor electron charging. However, geomagnetic response is expected to be limited and as such charging may also be minor. Therefore a slight increasing trend is possible, perhaps reaching Moderate levels during the period, with a slight chance of reaching a diurnal peak of High.

Electron fluence is currently well below the Active (1e8 integrated pfu) threshold. Whilst a rising trend is possible in response to any flux increase, it is unlikely to reach Active during the period. MOSWOC REFM also indicates a slight rising trend well below Active which is considered good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: GOES-16 Electron Fluence with REFM



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